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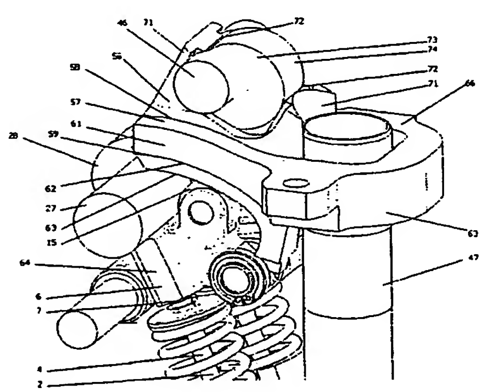

(57) Abstract: The invention relates to a mechanism (l) for varying the valve stroke of an internal combustion piston engine to any rate between zero stroke and nominal stroke, where there is a valve actuating camshaft (27), the cam (28) of which is constantly in contact with the contact surface (24) of a single-arm rocker lever (19); the single-arm rocker lever (19) is pinned on a stationary pin (23) at one of its ends, and at the other rotating end a rocker pivot (9) is fitted using an axis parallel with the stationary pin (23), on which one end of the lifting rocker lever (6) is pinned, and at the other end a pressure surface (7) resting on the stem (4) of the actuated valve (2) is arranged. According to the invention the lifting rocker lever (6) is fitted with a support surface (13) for turning around the rocker pivot (19), and it is permanently in contact with the guiding curve (35) of a guiding block (32) pinned in a movable way, the basic position of which is assigned to the zero stroke position of the valve (2) and the other extreme position is assigned to the nominal stroke position, with the middle stroke assigned to the current position in the middle, and the guiding block (32) is in communication with the engine control/regulator actuating member controlling the valve lift.

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A mechanism for varying the valve stroke of an internal combustion piston engine

Our invention relates to varying the valve stroke of an internal combustion piston engine, to allow regulating the output of an internal combustion Otto engine.

Concerning the engines of road vehicles, the most important objective and task today is reducing emission, and to achieve this the efficiency of burning the fuel must be increased, and fuel consumption along with the impact of various loss factors must be reduced. One of the factors causing a loss is the throttle valve used for regulating the output of the Otto engine in the intake pipe, which – as a result of the resistance caused by the same – limits the volume of air introduced into the combustion space of the engine. The regulation function can also be implemented by altering the opening period and lift height of the intake valve, which results in much lower losses than in the case of using the approach above. This solution requires a complicated and costly mechanism, which has been made cost efficient by the current circumstances and requirements.

Prior art approaches already implemented and used in mass production are principally identical with the mechanism described in the patent specification No. EP l.o39.1o3. The valve is pre-tensioned by a spring generally used in prior art, and it is actuated by the generally used prior art camshaft, with the valve stroke varying members fitted between the two. The range between zero stroke and nominal stroke is steplessly variable and control is provided by an electric drive motor through a governor disk. The valve stem supports a single-arm rocker with a roller in the centre, pressed by a guiding curve at the end of a rocker lever, as a result of its tangential displacement vis-à-vis the roller, which said displacement is caused by the cam of the camshaft. It is an important characteristic of the mechanism that the single-arm rocker and its actuating rocker lever with the guiding curve include an angle of almost 90 degrees and the path of lifting the cam is longer than the path of lifting the valve. As a result, the applicability of this approach is limited.

In creating this invention, our objective was the finding of a solution which is not only suitable for a valve actuated by a rocker arm, but is also expedient for moving the end of the valve stem directly, is compact, can be used for a double intake valve cylinder head, and also for multi-cylinder in-line engines, where the joint control of the cylinders in the line of cylinders can be carried out by a joint mechanical control unit operated by an electric drive motor.

The object of our invention is a mechanism for varying the valve stroke of an internal combustion piston engine, to any value between zero stroke and nominal stroke, which mechanism has a valve actuating camshaft, the cam of which is constantly in contact with the contact surface of a single-arm rocker lever, which is pinned at one end by using a stationary pin, and at the other rotating end a rocker pivot is fitted which has a parallel axis with a stationary support that allows rotation, preferably a pin, which holds one end of a lifting rocker lever, and on the other end there is a pressure surface resting on the stem of the actuated valve.

In the mechanism embodying our invention, the lifting rocker lever is fitted with a support surface for rotating around the rocker pivot, and it is constantly in contact with the guiding curve of a guiding block pinned in a movable way. The reset (basic) position of the said guiding block is assigned to the zero stroke position of the valve and the other extreme position to the nominal stroke position. To any position in-between, the midway stroke is assigned, and the guiding block is linked to the engine control/regulator actuating member which controls the valve lifting.

In a preferential embodiment of our invention, the geometrical axis of the rotary rocker pivot of the lifting rocker lever, the centreline of its pressure surface and the centreline of its support surface are at the apexes of an acute-angled triangle, the support surface of the lifting rocker lever is represented by the outer surface of a pinned roller, and the contact surface of the single-arm rocker lever is represented by the outer surface of a pinned roller.

In a further preferential embodiment of our invention, the guiding block runs in a straight guide in a plane normal to the camshaft, and the straight guide is preferably a cylindrical pin fitted with a member that secures it against turning, the guiding block is fitted with a rack engaged by the gear of a valve lift control member, and the axis of the said gear is preferably parallel with the camshaft.

In a further preferential embodiment of our invention, the single-arm rocker lever and the pin of the guiding block are arranged around the camshaft, in fact they preferably include an angle of 30 degrees in a plane normal to the camshaft, and between their intersection point and the camshaft is the lifting rocker lever, which has a loading hairpin spring to make sure that it rests on the guiding curve of the guiding block.

In a further preferential embodiment of our invention, two neighbouring valves have a separate lifting rocker lever each, with a joint pivot pin holding one single-arm rocker lever, and the single-arm rocker lever is in contact with a single cam.

In a further preferential embodiment of our invention, two neighbouring valves have a separate lifting rocker lever each, with a separate single-arm rocker lever fitted for each. Each single-arm rocker lever is in contact with a separate cam, and the single-arm rocker levers each have a separate guiding block, in the given case fitted with a different guiding curve.

In a further preferential embodiment of our invention, of the three neighbouring valves, the two extreme valves have a separate lifting rocker lever, with a single-arm rocker lever each, in contact with a separate cam each, and the two single-arm rocker levers have a joint rocker pivot pinned in a way allowing rotation in the bore of the single-arm rocker lever, the lifting rocker levers are fixed so that they rotate jointly on their rotary rocker pivots, and in the section of the rocker pivot between the two single-arm rocker levers there is a third lifting rocker lever fixed so that they rotate jointly, and having a pressure surface resting on the stem of the valve in the middle.

In a further preferential embodiment of our invention, the guiding curve of the guiding block has a starting section parallel with the guiding pin, to which a zero valve lift is assigned, the initial section is attached to a first lifting section, which is preferably straight and includes an angle of some degrees with the guiding pin, and the first lifting section adjoins a second lifting section, which is arc-shaped,

and the second section adjoins a third lifting section, which is preferably straight and includes an angle of approx. 60 degrees with the guiding pin.

In a further preferential embodiment of our invention which can be preferentially fitted primarily for high revolution engines, the guiding block has a curved guiding surface resting on a guide of identical curve, the arc is of concave shape when viewed from the rocker pivot, the guide is fixed in a stationary way, the plane normal to the generatrix of the curved guiding surface is advisably also normal to the geometrical axis of the camshaft, along the curved guiding surface, there is a movement surface advisably including the line normal to the guiding surface. This movement surface is on the pin of the guiding block, with which an eccentric arranged on a guiding shaft and arranged as an engine control/regulator actuating element to control valve lift is in contact.

In a further preferential embodiment of our invention, the eccentric located on the engine control/regulator eccentric shaft is between a movement surface on each of two pins fitted on the guiding block, advisably without play and the guide of the guiding block is arranged as a two-prong yoke fitted with a guiding surface each, and the opening of the yoke head is arranged in a way suitable for receiving the protective pipe of the spark plug.

In a further preferential embodiment of our invention, the guiding surface on the two-prong yoke is arranged on the valve side of the yoke prong, as a cylindrical surface section,

On the two opposite sides of the guiding block guides are arranged as a groove represent the guiding surfaces, between them the stems of the two-prong yoke are located with their guiding surfaces.

In a further preferential embodiment of our invention, a spring support surface is arranged on the lug receiving the single-arm rocker lever rocker pivot on the side opposite the guiding block, a pressure spring is supported by the spring support surface, a hydraulic lash adjustor is fitted into the lifting rocker lever, and the said adjustor has a pressure surface supported by the end of the valve stem.

In a futher preferential embodiment of our invention the mechanism arranged on one half of the cylinder head having a central spark plug, there are opposite movement surfaces in the yoke head of the guiding block, and the said surfaces are matched to the outer surface of the guiding shaft eccentric, the guiding shaft

is linked to the valve lift controlling engine control/regulator member, the guiding block has yoke prongs, with the prong ends fitted with bearing members, the geometrical axis of which is parallel with the generatrices of the movement surfaces and with the guiding shaft, on the inner side of the yoke head opposite the movement surfaces there are guiding surfaces including the guiding curve between the yoke prongs to support the outer surfaces of the rollers of the lifting rocker levers Preferebly at this embodiment the bearing members of the yoke prongs of the guiding block there are bores, arranged on the.stationary pin of the single arm rocker.lever.

Our invention is described in details by embodiment examples, depicting in figures the mechanism where the engine cylinder not shown has three and two intake valves, respectively.

Fig. 1 is an axonometric diagram of a mechanism featuring as the first embodiment example, which is suitable for actuating three intake valves,

Fig. 2 is the mechanism in zero stroke valve lift position,

Fig. 3 is the mechanism in a valve lift position,

Fig. 4 is the arrangement of the valve actuating lifting levers,

Fig. 5 is an axonometric diagram of a mechanism featuring as the second embodiment example, which is suitable for actuating two intake valves,

Fig. 6 is a different view of the mechanism in Fig. 5,

Fig. 7 is an axonometric diagram of the mechanism as a third embodiment example, which is suitable for actuating two intake valves, having a third type of valve lift regulating guiding block,

Fig. 8 is an axonometric diagram of the valve lift regulating guiding block of the mechanism in Fig. 7.

In the first embodiment example, the cylinder of the internal combustion piston engine not shown has three intake valves, the exhaust valves and their actuating mechanism are not shown, the valve arrangement of the cylinder head and its valve actuating mechanism is of a DOHC design. The engine is of the Otto type,

and its spark plug is in the centreline of the cylinder, surrounded by a protective pipe, the receiving cylinder head is not shown. The mechanism 1 actuates the valves 2 and 3, which have valve stems 4 and valve stem ends 5, they are actuated by shifting along the geometrical axis of the valve stem 4, and as a result of the mechanism 1 the rate of shift can be adjusted to any extent between zero and the nominal (maximum) value. The valve stem end 5 supports the pressure surface 7 of the lifting rocker lever 6 of the mechanism 1, and the shape of the said pressure surface is identical with a small detail of the cylinder surface, the centreline 8 of the pressure surface 7 is parallel with the axis of the rocker pivot 9 going through the bore 10 of the lifting rocker lever 6. The rocker pivot 9 is pinned in a way allowing rotation in the bore 20 of the single-arm rocker lever 19, and using its bore 22, it is pinned in a way allowing rotation on the stationary pin 23 fixed in the cylinder head casting not shown. Close to midway of the distance between bores 20 and 22 of the single-arm rocker lever 19, there is a bore 21, through which the pin 17 holds the roller 25, the surface 26 of which is constantly in contact with the outer surface 29 of the valve actuator cam 28 of the camshaft 27, the contact surface is situated along the generatrix 24 of the outer surface 26 of the roller 25, similarly to the outer surface 29 of the cam 28. The section associated with the approximately 240-degree central angle of the outer surface 29 of the cam 28 is the cylindrical surface section 31, and the rest of the section is the lifting and returning section 30. The camshaft 27 is pinned in a way allowing rotation in the cylindrical head casting not shown. When projected to a plane normal to the geometrical axis of the camshaft 27, of the three valves 2 and 3, respectively, the geometrical axis of the valve stem 4 of the two identical position valves 2 is situated near the geometrical axis of the camshaft 27. When projected to a plane normal to the geometrical axis of the camshaft 27, the pressure lever 11 of the lifting rocker lever 6 and the single-arm rocker lever 19 are basically one behind the other as a result of which their space requirement is minimal when measured in the direction of the geometrical axis of the valve stem 4.

The arrangement of the spark plug of the cylinder head not shown is central, and uniaxially with it is the protective pipe 47 in the immediate vicinity of which is the rocker pivot 9. As a result, during operation the single-arm rocker lever 19 and the pressure lever 11 of the lifting rocker lever 6 move in a scissors-like fashion around the rocker pivot 9. This design does not require much more space than a valve control actuated by a single-arm rocker lever. The space requirement of the design according to this embodiment example is larger than usual from the protective pipe 47 on the side outside of the camshaft 27, where the stationary pin 23 of the single-arm rocker lever 19 is pinned in the cylinder head casting not shown. Widening the casting manufactured in a large batch for the purpose of fitting the mechanism of the embodiment example generally does not cause any difficulty from the aspect of either the engine design or the production technology.

In addition to the pressure lever 11, the lifting rocker lever 6 also has the support lever 12, which in this embodiment example includes an angle of approx. 120 degrees, the support lever 12 is roughly parallel with the valve stem 4 and it faces the camshaft 27 in the zero valve stroke position of the mechanism 1. The support surface 13 and the centreline 14 of the support lever 12 are represented by the outer surface 16 of the roller 15 and its generatrix, the roller 15 runs on pin 17, which is fixed in the bore 18 of the support lever 12. The geometrical axis of the rotary rocker pivot 9 of the lifting rocker lever 6, the centreline 8 of the pressure surface 7 supported by the valve stem 4 and the centreline of the support surface 13 are located at the apexes of an acute-angled triangle.

The roller 15 of the support lever 12 is supported by the guiding curve 35 of the guiding block 32, which is a surface of straight generatrix. The guiding block 32 can be moved along a straight guide represented by the guiding pin 41, on which the guiding block 32 is supported with its bore 33, and the said guiding block has a protrusion 34 including an angle of approx. 30 degrees with the guiding pin 41. The guiding curve 35 consists of several sections, and roughly parallel with the guiding pin 41 is the starting section 36, to which the first section 37 is connected, this includes an angle of 1-2 degrees with the guiding pin 41, the

second section 38 is adjoined to the first section 37, and the former has an arched shape, but its radius 40 is longer than the radius of the roller 15, the second section 38 adjoins the third section 39, which is preferably straight lined and includes an angle of approx. 60 degrees with the guiding pin 41, and it is arranged on protrusion 34 of the guiding block 32. On the side opposite the guiding curve 35, the guiding block 32 has a rack 44 on the side 43 opposite the guiding curve, and this rack is engaged by the pinion 45. The pinion 45 which is shown as a full gear in the figure, is fixed in a stationary way on the guiding shaft 46, pinned in a way allowing rotation in the cylinder head casting not shown. By engaging the rack 44 and the pinion 45, the guiding block 32 is secured against turning, provided that its protrusion 34 has in its central plane the longitudinal axis of the guiding pin 41 and the central plane of the rack 44.

The resting of both rollers 15 and 25 on the guiding curve 35 and on the outer surface 29 of the cam 28 is provided by the spring 48, the curved end 49 of which is supported on the external surface 51 of the bearing case 50 of the lifting rocker lever 6, and the fixing end 52 of the spring 48 is fixed in a way not shown to the cylinder head casting, and the spring 48 is arranged as a hairpin spring.

As shown in Fig. 1, the mechanism 1 according to the description above is suitable for actuating a single valve 2. The components of the mechanism 1 to be described below enable the actuation of two valves 2 and then three valves 2 and 3.

On the stationary pin 23 of the mechanism 1, there are two single-arm rocker levers 19 side by side, the rollers 25 of which are each in contact with the outer surface 29 of a cam 28, and the same rocker pivot 9 passes through their bores 2. On the rocker pivot 9, around the single-arm rocker levers 19, a lifting rocker lever 6 for each is fixed in a stationary way, and their pressure surfaces 7 are supported by the valve stem end 5 of each valve 2. The precondition for this is that the shape and angular position of the two cams 28 should be identical. In the middle section 53 of the rocker pivot 9 there is a central lifting rocker lever 54 fixed in a stationary way with its bore 55, and its pressure surface 7 is supported by the valve stem end 5 of the central valve 3. The central lifting rocker lever 54

is not fitted with a support lever like the two extreme position lifting rocker levers 6, which have support levers 12. For each of the two lifting rocker levers 6 a guiding block 34 fitted with a guiding curve 35 is assigned separately, which have separately a guiding pin 41 fixed in the cylinder head casting not shown. Between guiding pins 41 is the protective pipe 47. A web 42 connects and combines into a solid member the two guiding blocks 34, on web 42 is the rack 43, which is engaged by the pinion 44 or gear as shown fixed to the guiding shaft 46. The turning of the guiding shaft 46 varies the stroke of lifting the valve 2. To turn the guiding shaft 46, an electric drive motor not shown is fitted.

The mechanism 1 is suitable for actuating both intake and exhaust valves.

The mechanism 1 operates as follows:

In the position shown in Fig. 1, the mechanism 1 is in a zero valve lift position. In spite of that, the mechanism 1 is ready to move, and when the camshaft 27 turns, the cam 28 actuates the roller 25, turning the single-arm rocker lever 19 around the stationary pin 23, and thereby the rocker pivot 9 must also move along an arc, as a result of which the lifting rocker lever 6 must turn around the rocker pivot 9. The extent of turn is determined by the guiding curve 35 of the guiding block 32, and a zero valve lift is associated with the starting section 36 of the guiding curve. The length of the starting section 36 is selected in a way that the roller 15 rolls along it without influencing the free turning of the lifting rocker lever 6 around the rocker pivot 9, and therefore the pressure surface 7 of the lifting rocker lever 6 does not make a movement at the valve end 5 of the valve 2 in the direction of valve stem 4, without displacing the valve 2, and the extent of valve lift is zero. When the camshaft 27 is continuously rotating, the roller 15 of the support lever 12 of the lifting rocker lever 6 rolls back and forth on the starting section 36 of the guiding curve 35. The continuous contact of the rollers 15 with the guiding curve 35 and with the outer surface 29 of the cam 28 is ensured by the tension of the spring 48.

For varying the zero valve lift, the guiding shaft 46 is turned – for example by means of the drive motor not shown – as a result of which the pinion 44 moves the rack 43, and along with it the guiding block 32 with its guiding curve 35 is also

moved, in fact this is carried out in the direction of the camshaft 27 on the guiding pin 41. Even in the case of a maximum displacement, the roller 15 is in contact with the starting section 36 of the guiding curve 35, when the roller 25 of the single-arm rocker lever 19 is in contact with the cylindrical outer surface 31 of the cam 28. When the lifting section 30 of the cam 28 turns the single-arm rocker lever 19, the roller 15 of the lifting rocker lever 6 rolls on the first section 37 of the guiding curve 35, and the pressure lever 11 of the lifting rocker lever 6 starts to displace the valve 2 in an opening direction until the roller 15 reaches the highest point of the lifting section 30 of the cam 28, and then going beyond that point the valve 2 moves in a closing direction until full closure. When a maximum, nominal valve lift is adjusted, and the cam 28 reaches the peak point of the lifting section 30, the roller 15 of the lifting rocker lever 6 rolls along the first 37, second 38 and third 39 sections of the guiding curve 35, which third section is arranged on protrusion 34 of the control unit 32. The relationship between radius 40 of the second section 38 and the radius of the roller 15 influences the extent of high valve acceleration occurring at the time and following the valve opening. Because both cams 28 simultaneously lift the associated single-arm rocker lever 19, both lifting rocker levers 6 simultaneously actuate the valve 2 which is in contact, and furthermore the central lifting rocker lever 53 turns together with the lifting rocker levers 6, because all the three are steadily fixed on the rocker pivot 9, and hence valve 3 in the middle is moved.
It is an advantageous characteristic of the mechanism 1 that the lifting displacement of the valve end 5 of the valve 4 is larger than the lifting height of the cam 28.

A mechanism corresponding to the second embodiment example and suitable for actuating two valves 2 is shown in Figs. 5 and 6.
The design enables the fitting of the mechanism into high revolution engines, which need limited lash adjustment for low noise and long life; this can be achieved by fitting a hydraulic lash adjustor for each valve.

In the second embodiment example, the guiding block 56 is guided along a curved guiding curve 57 for ensuring movement, the curve is of concave shape when viewed from the valve 2 and the rocker pivot 9, respectively, and it is arranged as a cylindrical surface section. The geometrical axis of the cylindrical surface is parallel with the camshaft 27 and on both sides 57 of the guiding block 56 the opposite surfaces 59 of each guiding groove 58 represent the guiding surfaces, between which the prongs 61 of a double-prong yoke 60 are fitted with their guiding surfaces 62 arranged as a counter-surface. The yoke head 63 of the two-prong yoke 60 is screwed to the cylinder head casting not shown, and the yoke head 63 and the stems 61, respectively, are located around the protective pipe 47 of the spark plug not shown in the geometrical axis of the engine cylinder.

The mechanism 1 has one single-arm rocker lever 19, the roller 25 of which is in permanent contact with the single roller 28. On the rocker pivot 9 of the single-arm rocker lever 19 there are two lifting rocker levers 6 arranged in a way allowing rotation, on the pressure surface 7 of which, supported by the valve stem end 5 of the valve stem 4 of the valve 2, a hydraulic lash adjustor 64 is fitted according to prior art solutions and supplied with compressed oil in the lifting rocker lever 6. The roller 15 running on pin 17 and secured in the support lever 12 rests on the guiding surface 70 including the guiding curve 65 of the guiding block 56, and this said guiding surface – similarly to the first embodiment example – has starting section 66, first section 67, second section 68 and third section 69. The actuating task of each section is identical with that described in the first embodiment example, but the shapes of the starting section 66 and the first section 67 are different, because they are curved surfaces, the arc of which is matched to the curved shape of the surfaces 59 of the guiding groove 58 of the guiding block 56, and this said curve has an identical curving with the guiding surface 62 of the stem 61 of the yoke 60, and when running on this guiding surface, the guiding groove 57 enables the guiding block 56 to move. Arranged on the two pins 71, an actuating surface 72 including the line normal to the guiding surface 62 is around the eccentric 73 arranged on the control shaft 46 at

the outer surface 74, the turning of which regulates the extent of lifting the valve 2. The roller 15 must be continuously supported by the guiding surface 70, and to this end on the single-arm rocker lever 19, in the vicinity of the bore 10 receiving the rocker pivot 9, on a side opposite the guiding block 32, a spring support surface 75 is arranged to support pressure spring 76. The pressure spring 76 is fitted between a suitable surface of the cylinder head not shown and the spring support surface 75 of the single-arm rocker lever 19.

The guiding surface 62 of the stem 61 of the yoke 60 is a full curve-shaped cylindrical outer surface. An arc with the same centre is the starting section 66 of the guiding curve 65 of the guiding pin 32, and the first section 67 is arranged with an arc of a radius not so much different, and to this a zero valve lift is assigned, and to the latter only a lift not exceeding the lash is assigned. The radius of the second section 68 is changing continuously i.e. decreasing in an expedient way, until it approaches the radius of roller 15 and then the radius is continuously increasing until infinity, with a transition to the third section 69 which is expediently a flat surface with a straight generatrix. The shape of the fourth section 69 is not determined by operating requirements, but technologically a flat surface is recommended.

The mechanism 1 according to the second embodiment example works as follows:

The mechanism 1 changes the extent of lifting the valve 2 in a way that the control shaft 46 arranged as an engine control/regulating actuating member not shown turns together with the eccentric 73 fixed on it, and the outer surface 75 of the said eccentric displaces the movement surface 72 of the pin 71. As a result, the guiding block 32 slips on the guiding surface 62 of the prong 61 of the yoke 60, which said guiding surface is cylindrical. Consequently, the guiding block 32 moves along an arc, and it includes the guiding curve 65 and the guiding surface 70, which supports the roller 15.

In other respects, the operation of the mechanism shown in the second embodiment example is identical with that of the first embodiment example.

In the third embodiment example, the design of the single-arm rocker lever 19 and its lifting rocker levers 6 pinned on its rocker pivot 9 is identical with that in the second embodiment example, and they actuate two valves 2. To vary the extent of valve stroke, the guiding shaft 46 fitted with the eccentric 73 is fitted, and the outer surface 74 of the eccentric 73 is in contact with the movement surfaces 72 located in the yoke head 79 of the guiding block 77. The said guiding block 77 is arranged in a way that it can be tilted around the axis of rotation and has the yoke prongs 79, at the ends 80 of which the pins 81 are fitted, and their geometrical axis is parallel with the generatrix of the movement surfaces 72 and with the guiding shaft 46, respectively.

The pins 81 are pinned in the cylinder head casting not shown. Between the yoke prongs 79 of the guiding block 77, on the inner side 82 of the yoke head 78, the guiding surface 84 including the guiding curve 83 is located. The guiding curve 83 and the guiding surface 84, respectively, has the same sections as the guiding curve 65 and the guiding surface 70, respectively. The rollers 15 of the lifting rocker levers 6 have outer surfaces 16 resting on the guiding surfaces 84.

The mechanism 1 featuring in the third embodiment example operates as follows:

The mechanism 1 varies the extent of lifting the valve 2 by turning the guiding shaft 46 arranged as an engine control/regulator member together with the eccentric 73 fixed on the said guiding shaft 46, and the outer surface of the said eccentric 73 displaces the movement surface 72 of the guiding block 77. Hence, the guiding block 77 turns around the pins 81 on the yoke prongs. The roll 15 is supported by the guiding curve 65 and the guiding surface 70 of the guiding block 77, and the said curve and surface move along an arc.

In other respects, the operation of the mechanism in the third embodiment example is identical with that in the second embodiment example.

Claims

1. A mechanism /1/ for varying the valve stroke of an internal combustion piston engine to any rate between zero stroke and nominal stroke, where there is a valve actuating camshaft /27/, the cam /28/ of which is constantly in contact with the contact surface /24/ of a single-arm rocker lever /19/; the single-arm rocker lever /19/ is pinned on a stationary pin /23/ at one of its ends, and at the other rotating end a rocker pivot /9/ is fitted using an axis parallel with the stationary pin /23/, on which one end of the lifting rocker lever /6/ is pinned, and at the other end a pressure surface /7/ resting on the stem /4/ of the actuated valve /2/ is arranged,

characterised in that

the lifting rocker lever /6/ is fitted with a support surface /13/ for turning around the rocker pivot /9/, and it is permanently in contact with the guiding curve /35/ of a guiding block /32/ pinned in a movable way, the basic position of which is assigned to the zero stroke position of the valve /2/ and the other extreme position is assigned to the nominal stroke position, with the middle stroke assigned to the current position in the middle, and the guiding block /32/ is in communication with the engine control/regulator actuating member controlling the valve lift.

2. A mechanism according to Claim 1

characterised in that

the geometrical axis of the rotary rocker pivot /9/ of the lifting rocker lever /6/, the centreline of its pressure surface /7/ and the centreline of its support surface /13/ are at the apexes of an acute-angled triangle.

3. A mechanism according to Claim 2,

characterised in that

the support surface /7/ of the lifting rocker lever /6/ is represented by the outer surface /16/ of a pinned roller /15/ and the contact surface /24/ of the single-arm rocker lever /19/ is represented by the outer surface /26/ of a pinned roller /25/.

4. A mechanism according to Claim 1,

characterised in that
the guiding block /32/ moves in a straight guide /41/ in a plane normal to the camshaft /27/.

5. A mechanism according to Claim 1,
characterised in that
the guiding block /32/ is guided by a cylindrical pin /41/ and is fitted with a member by means of a bore /33/ to secure the said guiding block /32/ against turning, the guiding block /32/ is fitted with a rack /44/ engaging the gear /45/ of the member which controls the valve lift, and the shaft /46/ of this gear /45/ is preferably parallel with the camshaft /27/.

6. A mechanism according to Claim 5,
characterised in that
the single-arm rocker lever /19/ and the guiding block /32/ pin /41/ are arranged around the camshaft /27/, and they preferably include an angle of 30 degrees in a plane normal to the camshaft /27/, and the lifting rocker lever /19/ is situated between their point of intersection and the camshaft /27/.

7. A mechanism according to Claim 1,
characterised in that
the lifting rocker lever /6/ has a loading hair spring /48/ so as to rest on the guiding curve /35/ of the control unit.

8. A mechanism according to Claim 1,
characterised in that
each of the two neighbouring valves /2/ has a lifting rocker lever /6/ separately, with a joint rotary pivot /9/ pinned in a single single-arm rocker lever /19/, which is in contact with a single cam /28/.

9. A mechanism according to Claim 1,
characterised in that
each of the two neighbouring valves /2/ has a lifting rocker lever /6/ separately, with each having a separate single-arm rocker lever /19/, in contact with a cam /28/, and each single-arm rocker lever /19/ has a guiding block /32/ separately, in the given case fitted with a different guiding curve /35/.

10. A mechanism according to Claim 1,
c h a r a c t e r i s e d i n t h a t
of the three neighbouring valves /2/, the two extreme valves /2/ have a separate lifting rocker lever /6/, with a separate single-arm rocker lever /19/ for each, and each one is in contact separately with a cam /28/, and the two single-arm rocker levers /19/ have a joint pin /9/ rotating in the bore /20/ of the single-arm rocker lever /19/, the lifting rocker levers /6/ are fixed in a way so as to enable turning jointly on their rotary pivots /9/, in the section of the pivot /9/ between the two single-arm rocker levers /19/, and they have a third lifting rocker lever /54/ fitted in a way so as to allow turning jointly, with the pressure surface /7/ resting on the stem /4/ of the valve /3/ in the middle.

11. A mechanism according to Claim 1,
c h a r a c t e r i s e d i n t h a t
the guiding block /32/ has a guiding curve /35/ with a starting section /36/ parallel with the guiding pin /41/, to which a zero valve lift is assigned, and to the starting section /36/ a first lifting section /37/ is adjoined, which expediently includes an angle of a few degrees with the guiding pin /41/, the first lifting section /37/ is adjoined to a second lifting section /38/, which is of curved shape, and the second lifting /38/ section is adjoined to a third lifting section /39/ which is advisably straight and includes an angle of approx. 60 degrees with the guiding pin /41/.

12. A mechanism according to Claim 1,
c h a r a c t e r i s e d i n t h a t
the guiding block /56/ has a curved guiding surface supported by a guide /57/ of identical curve, the curve is of concave shape when viewed from the rocker pivot /9/, and the guide /57/ is fixed in a stationary way, the plane normal to the generatrix of the curved guiding curve is preferably also normal to the geometrical axis of the camshaft /27/.

13. A mechanism according to Claim 12,
c h a r a c t e r i s e d i n t h a t

along the curved guiding surface /57/, a movement surface /72/ preferably including a plane normal to the guiding surface is arranged on the pin of the guiding block /56/ for moving the said guiding block /56/, with which surface the eccentric /73/ arranged on the guiding shaft /46/ and arranged as a valve lift controlling engine control/regulator actuating member is in contact.

14. A mechanism according to Claim 13,
characterised in that
the eccentric /73/ arranged on the engine control/regulator eccentric shaft /46/ is in-between a movement surface /72/ on each of the two pins fitted on the guiding block /56/, preferably without clearance.

15. A mechanism according to Claim 14,
characterised in that
the guide /57/ of the guiding block /56/ is arranged as a two-prong yoke /60/ fitted with a guiding surface /62/ each, and the opening of the yoke head is arranged to be suitable for receiving the protective pipe /47/ of a spark plug.

16. A mechanism according to Claim 15,
characterised in that
on the two-prong yoke /60/, the guiding surface is arranged as a cylindrical surface section on the valve side of the yoke prong.

17. A mechanism according to Claim 16,
characterised in that
in the lug receiving the rocker pivot /9/ of the single-arm rocker lever /19/, a spring support surface /75/ is arranged on the side opposite the guiding block /56/, and a pressure spring /76/ is supported by the spring support surface /75/.

18. A mechanism according to Claim 17,
characterised in that

a hydraulic lash adjustor /64/ is fitted into the lifting rocker lever /6/, and this said mechanism has a pressure surface supported by the end of the valve stem /4/.

19. A mechanism according to Claim 16,

characterised in that

on the two sides /57/ of the guiding block /56/, guides are arranged as a groove /58/ having opposite guiding surfaces /59/, and between them are the stems /61/ – featuring guiding surfaces /62/– of the two-prong yoke /60/ .

20. A mechanism according to Claim 1,

characterised in that

there are opposite movement surfaces /72/ in the yoke head /78/ of the guiding block /77/, and the said surfaces are matched to the outer surface /74/ of the guiding shaft /46/ eccentric /73/, the guiding shaft /46/ is linked to the valve lift controlling engine control/regulator member, the guiding block /77/ has yoke prongs /79/, with the prong ends /80/ fitted with bearing members /81/, the geometrical axis of which is parallel with the generatrices of the movement surfaces /72/ and with the guiding shaft /46/, on the inner side /82/ of the yoke head /78/ opposite the movement surfaces /72/ there are guiding surfaces /70/ including the guiding curve /65/ between the yoke prongs /79/ to support the outer surfaces of the rollers /15/ of the lifting rocker levers /6/.

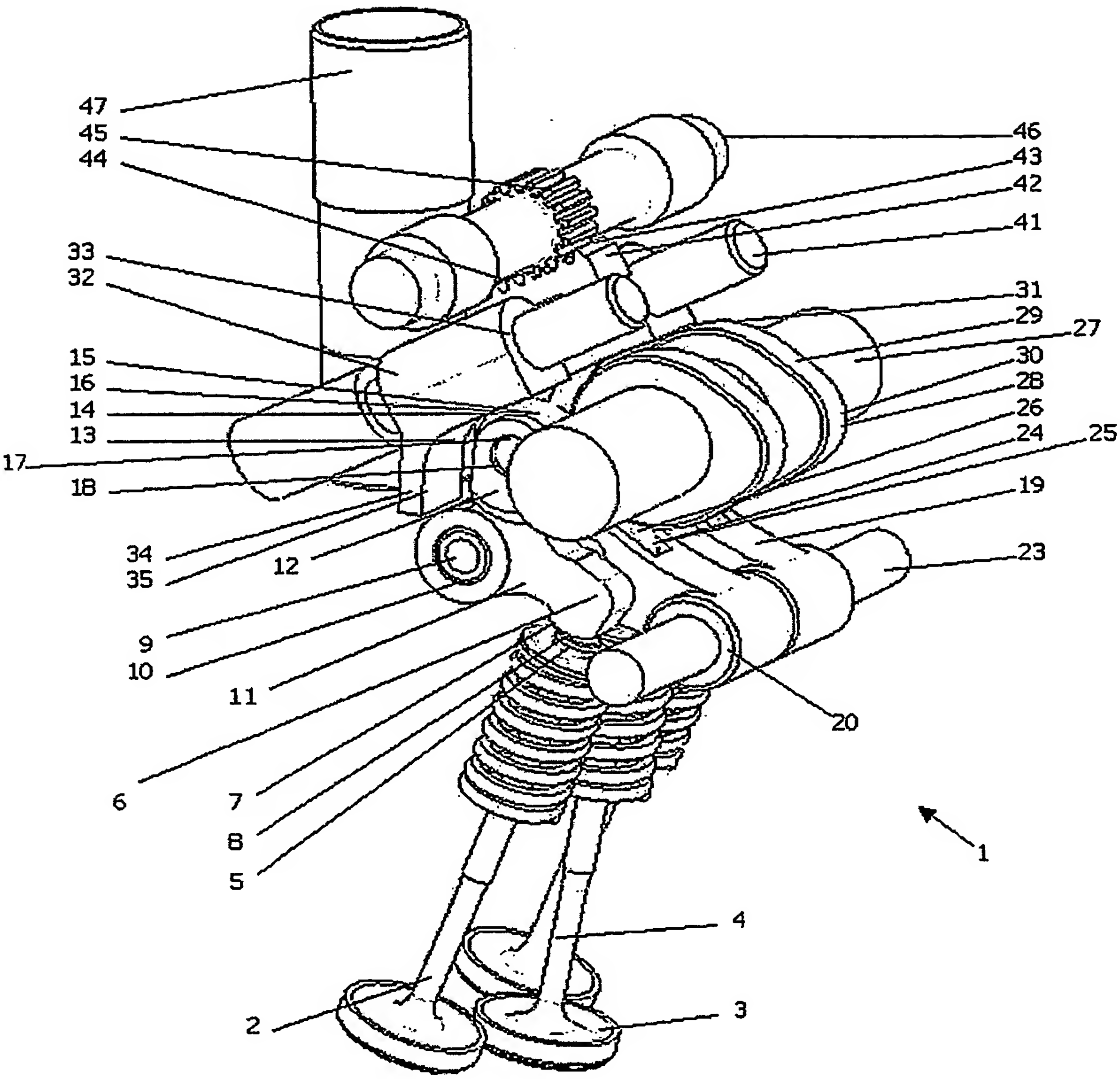
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Fig. 1.

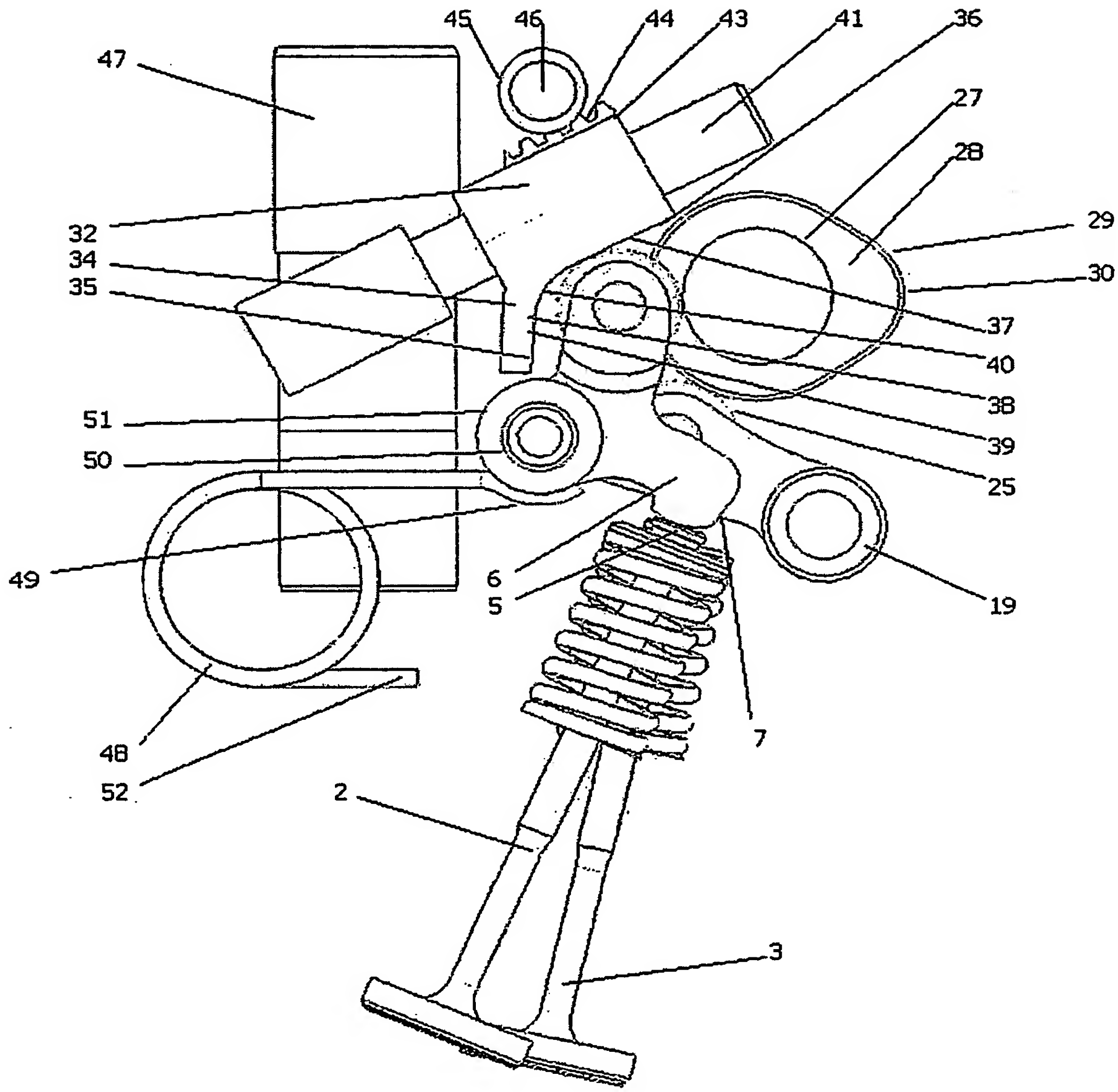
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Fig. 2.

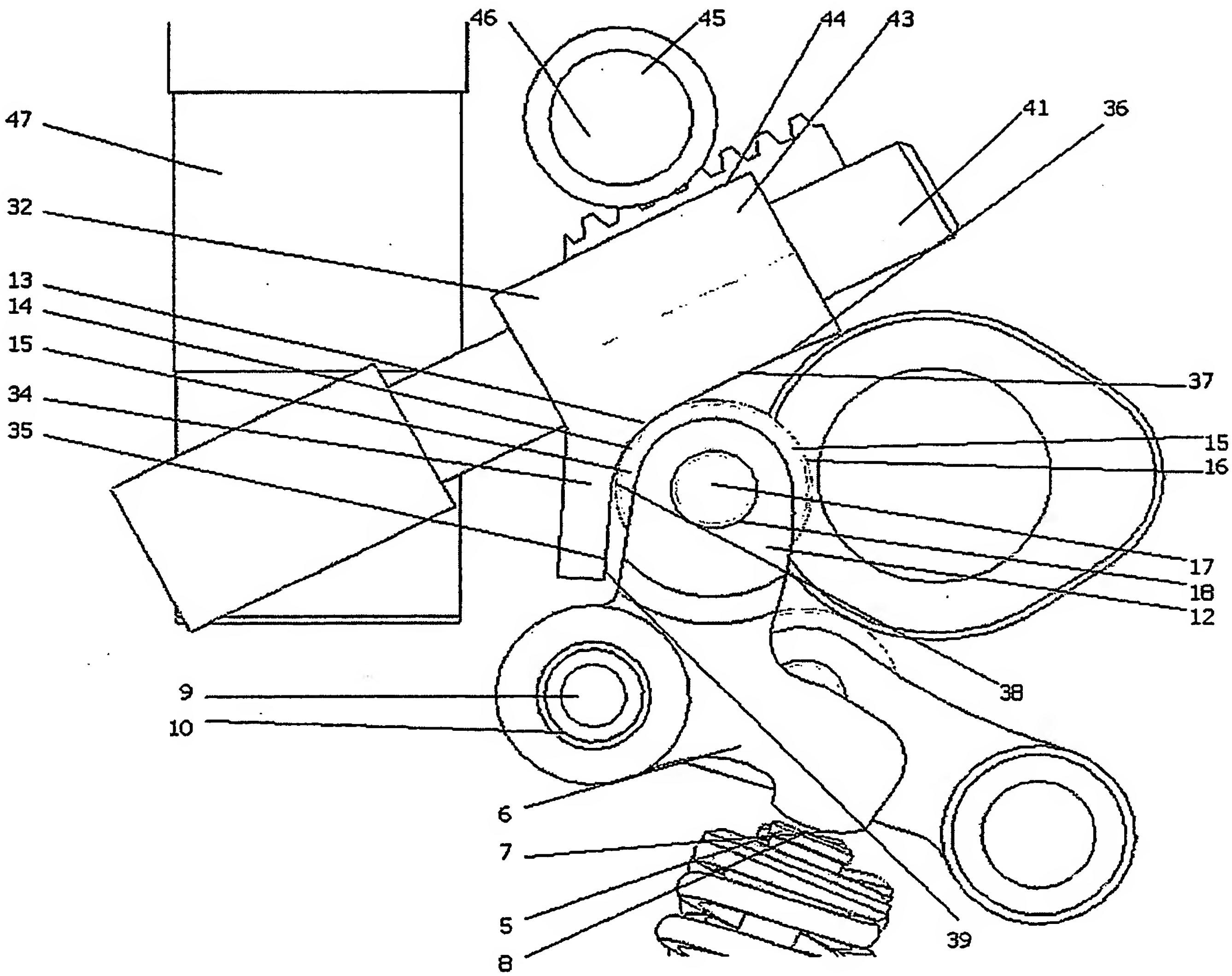

Fig. 3.

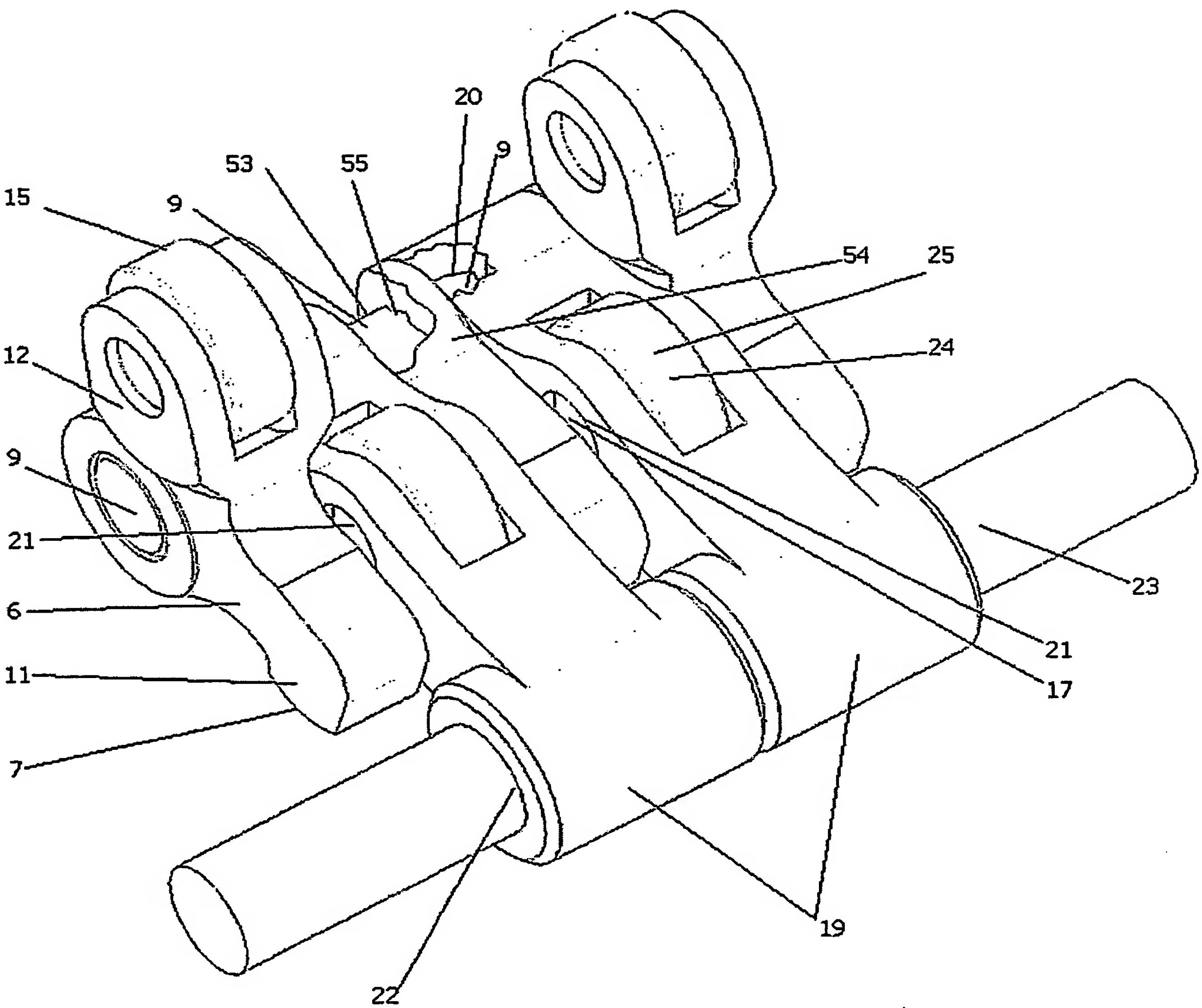

Fig. 4.

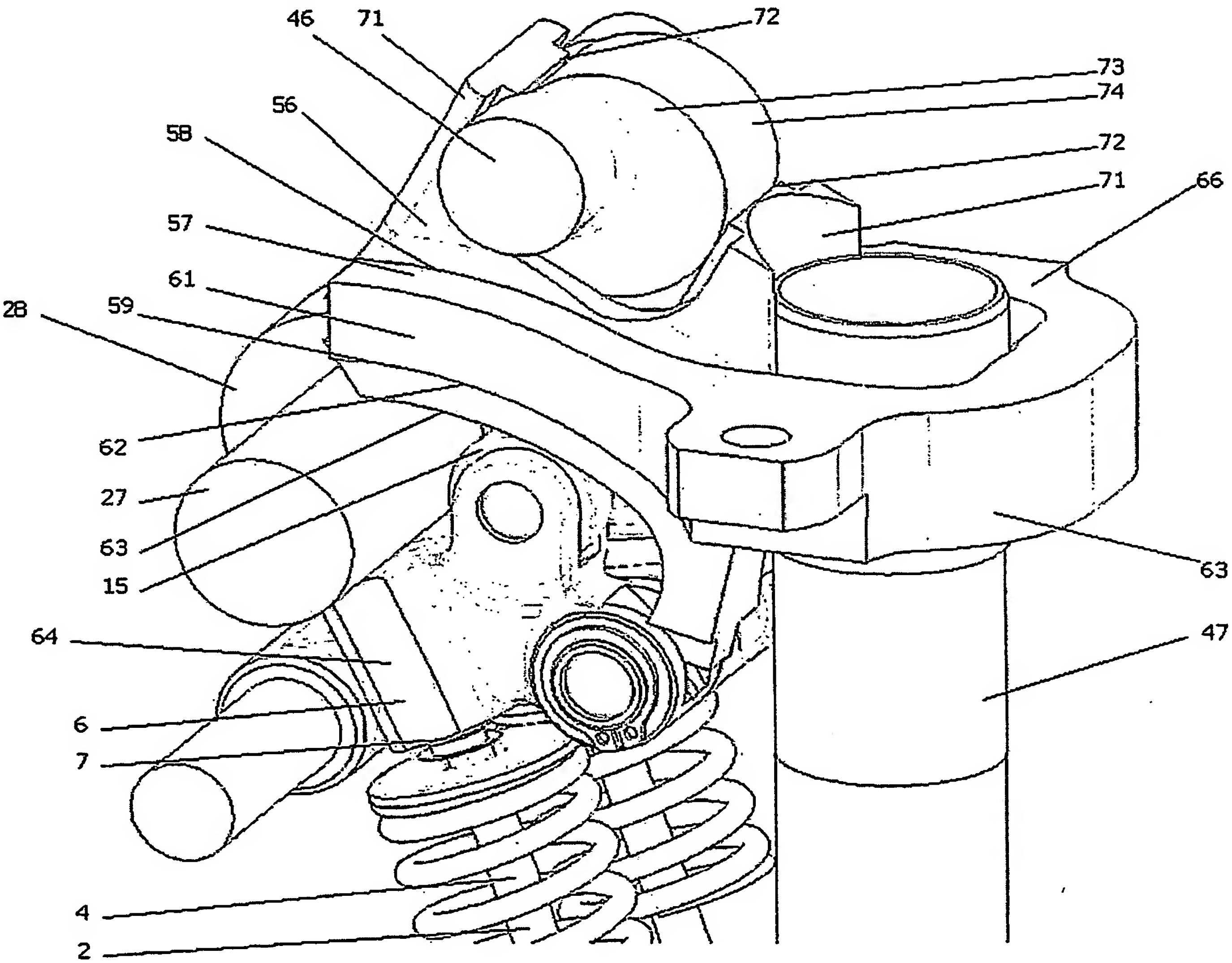

Fig. 5.

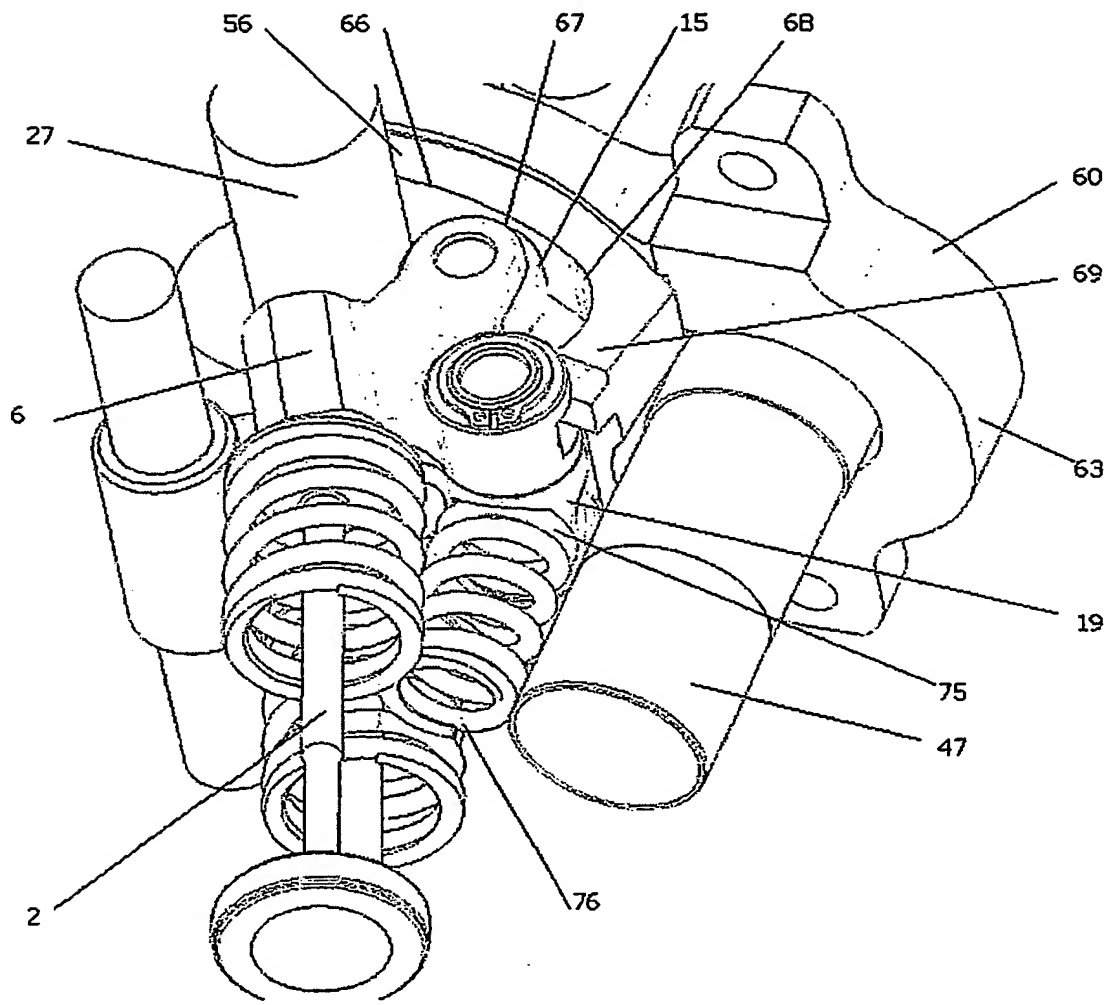

Fig. 6.

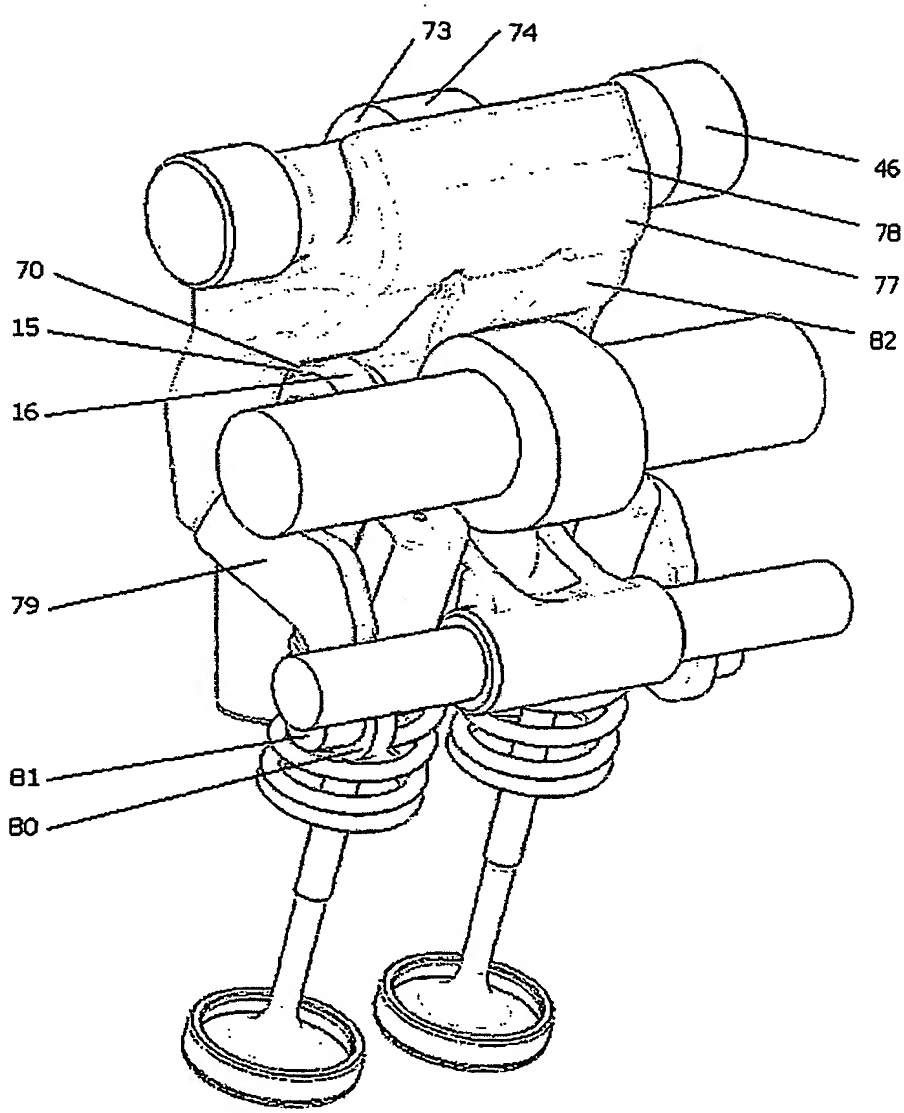

Fig. 7.

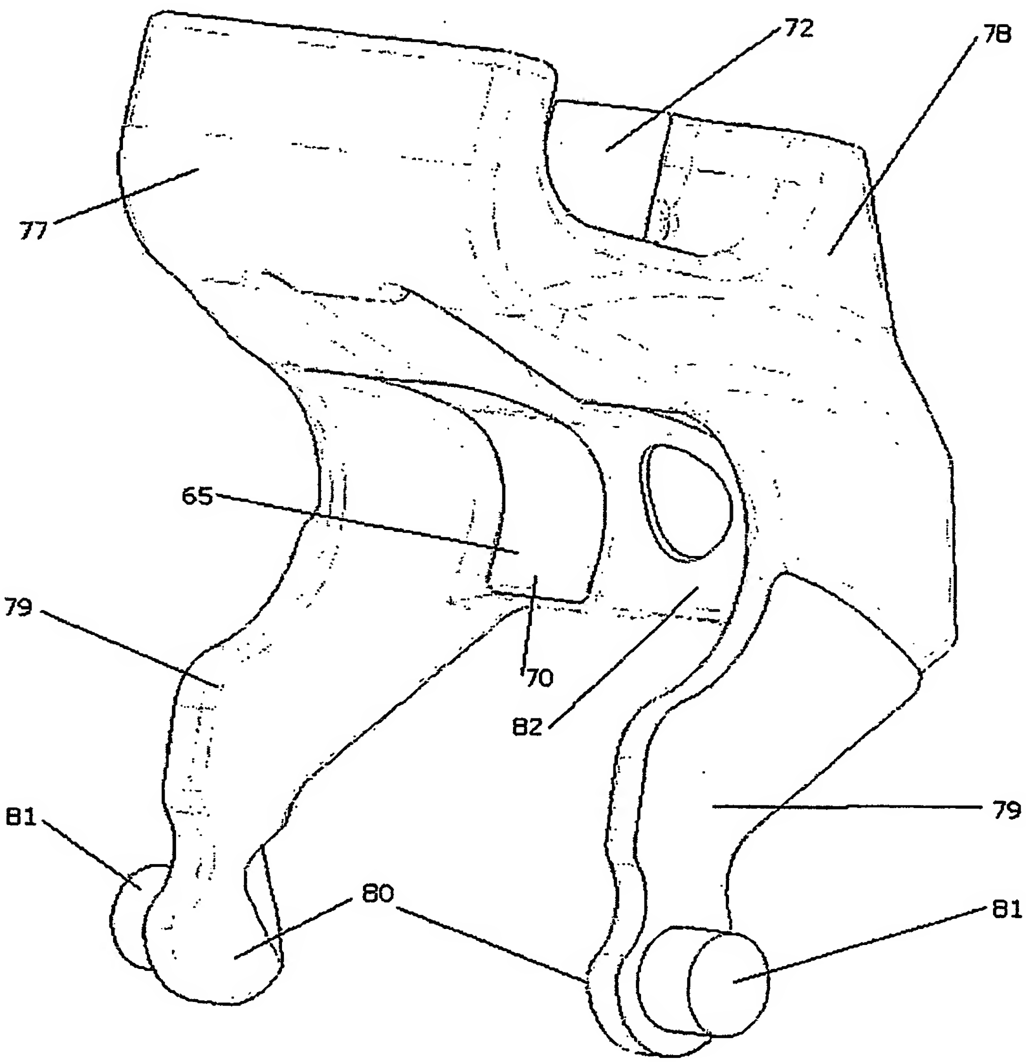

Fig. 8.

INTERNATIONAL SEARCH REPORT

Intern: " ' Application No
PCT, ... 03/00058

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F01L13/00 F01L1/26 F01L1/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	PATENT ABSTRACTS OF JAPAN vol. 005, no. 116 (M-080), 25 July 1981 (1981-07-25) & JP 56 056914 A (MAZDA MOTOR CORP), 19 May 1981 (1981-05-19) abstract; figure 1	1-3
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A	the whole document	17
A,P	DE 101 55 007 A (NAUMANN HERBERT) 15 May 2003 (2003-05-15) the whole document	1,7

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 November 2003	17/12/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Klinger, T

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